Claims

1. An injection molding apparatus provided with a central control and with a screw which extends in a cylinder, which cylinder is provided with a filling opening and with a nozzle, the screw being drivingly connected to two controllable electric motors such that a movement in rotational and/or axial sense can be imposed on the screw, the driving connection comprising a number of cylindrical planetary rollers accommodated for rotation in a planetary cage such that the planetary rollers can be engaged from a space located radially outside the planetary cage and a space located radially within the planetary cage, the planetary cage being connected to the screw in a manner secured against rotation and translation, while a first drive part, connected to a rotor of the first electric motor, is provided with a first engaging surface facing radially inward which engages the planetary rollers from the space located radially outside the planetary cage, while a second drive part, connected to a rotor of the second electric motor, is provided with a second engaging surface facing outwards which engages the planetary rollers from a space located radially within the planetary cage.

2. An injection molding apparatus according to claim 1, wherein the planetary rollers are provided with parallel grooves and backs bounding each other mutually and which are located in planes extending perpendicularly to a central axis of a respective planetary roller, the first engaging surface comprising inner thread and the second engaging surface comprising external thread while the hand of the inner thread is opposite to the hand of the outer thread.

3. An injection molding apparatus according to claim 2, wherein the internal thread has a similar angle pitch to the external thread but opposite hand.

4. An injection molding apparatus according to claim 1, wherein the planetary rollers are provided with external thread.

5. An injection molding apparatus according to claim 4, wherein the first engaging surface is provided with parallel grooves and backs bounding each other mutually and which are located in planes extending perpendicularly to a central axis of the first drive part.

6. An injection molding apparatus according to claim 4 or 5, wherein the second engaging surface is provided with parallel grooves and backs bounding each other mutually and which are located in planes extending perpendicularly to a central axis of the second drive part.

7. An injection molding apparatus according to any one of the preceding claims, wherein the first drive part is fixedly connected to the rotor of the first electric motor, while the second drive part is fixedly connected to the rotor of the second electric motor.

8. An injection molding apparatus according to any one of the preceding claims, wherein each electric motor is provided with its own motor control, the injection molding apparatus being provided with a central control which is arranged for passing desired values of a particular control quantity to the two motor controls, while in some phases of the injection process, the control quantity values passed by the central control are determined on the basis of force measurements or motor current measurements while in other phases they are determined on the basis of the desired positions of the screw in the cylinder.

9. An injection molding apparatus according to claim 8, wherein the central control is arranged for having the injection molding apparatus traverse a plasticizing phase, and injection phase and, optionally, and after-pressure phase.

10. An injection molding apparatus according to claim 8, wherein, for the purpose of the regulation based on force feedback, the central control measures as input signal the electric current used by the first electric motor

and the electric current used by the second electric motor, while the central control is arranged for determining, on the basis thereof, control quantity values to be passed to the motor controls to thus regulate the filling pressure according to a desired pattern.

11. An injection molding apparatus according to claim 8, wherein the injection molding apparatus is provided with at least one force sensor, such as for instance, piezoelectric elements or strain gauges, which measures a force exerted by the screw, the at least one force sensor being connected to the central control for the purpose of the force feedback, while the central control is arranged for determining control quantity values on the basis of a signal produced by the at least one force sensor, to be passed to the motor controls to thus regulate the filling pressure according to a desired pattern.

12. An injection molding apparatus according to any one of the preceding claims, wherein the electric motors each comprise a servomotor, each of which being provided with its own motor control, while the central control is arranged for generating control quantity values of the same type and passing these control quantity values to the motor controls of the servomotors.

13. An injection molding apparatus according to any one of claims 8 - 12, wherein the control quantity is selected from the group comprising position, speed, acceleration and jerk, while the selection can also comprise a combination of these quantities.

14. An injection molding apparatus according to claims 2 and 10, wherein the pitch of the internal thread and the external thread is so large that the axial force the screw experiences in use can be accurately derived from the motor current used by the first and second electric motor.

15. An injection molding apparatus according to any one of the preceding claims, wherein the first and the second electric motor are coaxially arranged.

16. An injection molding apparatus according to any one of the preceding claims, wherein the drive housing is mounted on a slide which is

provided with a, preferably electric, drive for moving the drive housing and the cylinder connected therewith in axial direction.

17. A method for manufacturing an injection molded product while utilizing an injection molding apparatus according to any one of the preceding claims, wherein the rotational direction and the rotational speed of the first and second electric motor are varied such that the planetary cage and hence the screw are operatively rotated and/or translated in axial direction according to a desired pattern and/or while exerting a desired axial force, while the power required for the axial translation is provided by the two electric motors and the power required for the rotation is provided by the two electric motors.

18. A method according to claim 17, wherein the injection molding apparatus traverses in one cycle a plasticizing phase, an injection phase and, optionally, an after-pressure phase.

19. A method according to claim 17, wherein the central control based on force feedback calculates desired control quantity values and passes these control quantity values to the two motor controls of the two electric motors, while in the injection phase, independently of forces associated therewith, the central control directly passes desired control quantity values to the two motor controls.

20. A method according to claim 19, wherein, for the purpose of the regulation based on force feedback, the central control obtains as input signal the electric current used by the first electric motor and the electric current used by the second electric motor, while, on the basis thereof, the central control passes control quality values to the motor controls so that the filling pressure proceeds according to a desired pattern.

21. A method according to claim 19, wherein, for the purpose of the regulation based on force feedback, the central control obtains as input signal the force measuring signals detected by the force sensors on the screw, while, on the basis thereof, the central control passes desired control quantity values

to the motor controls so that the filling pressure proceeds according to a desired pattern.

22. A method according to any one of claims 19 - 21, wherein the control quantity is the position, the speed, the acceleration or jerk or a combination thereof.